

CLEANING BEHAVIOUR OF ROCK COOK, *CENTROLABRUS EXOLETUS* (LABRIDAE), IN TARIFA (GIBRALTAR STRAIT AREA)

by

M.D. GALEOTE & J.G. OTERO (1)

ABSTRACT. - Cleaning behaviour is reported for rock cook (*Centrolabrus exoletus*) in their natural habitat at Isla de las Palomas (Tarifa, Gibraltar Strait area). Behavioural sequences of cleaning are described, and the contents of 92 guts were examined. Field observations and food analysis indicate that the rock cook is a facultative cleaner. Both juveniles and adults cleaned throughout the whole year, especially to species of families Labridae, Pomacentridae, Sparidae and Serranidae. Diet consists primarily of free-living copepods and gnathiid isopod larvae (*Gnathia* sp.). Comparisons are made between rock cook and the most active cleaner in the Mediterranean, *Symphodus* (*Crenilabrus*) *melanocercus*.

RÉSUMÉ. - Le comportement de nettoyage de *Centrolabrus exoletus* (Labridae) à Tarifa (Déroit de Gibraltar).

Le comportement de nettoyage de *Centrolabrus exoletus* a été observé en milieu naturel, au large de l'île de las Palomas (Tarifa, zone du Déroit de Gibraltar). Le présent article comporte une description des séquences comportementales observées au moment du nettoyage ainsi qu'une étude des contenus intestinaux de 92 individus. Les résultats des observations subaquatiques et de l'analyse de l'alimentation indiquent que *Centrolabrus exoletus* est un nettoyeur facultatif. Les jeunes comme les adultes pratiquent le nettoyage pendant toute l'année, spécialement vis-à-vis d'espèces appartenant aux familles suivantes: Labridae, Pomacentridae, Sparidae et Serranidae. L'alimentation de ce poisson nettoyeur comprend principalement des copépodes de vie libre et des larves d'isopodes Gnathidés. Comparaison est faite entre *Centrolabrus exoletus* et *Symphodus* (*Crenilabrus*) *melanocercus*, le nettoyeur le plus actif de la Méditerranée.

Key-words. - Labridae, *Centrolabrus exoletus*, MED, Gibraltar Strait area, Cleaning behaviour, Feeding habits.

Cleaning symbiosis has been broadly reported among tropical marine fishes (Eibl-Eibesfeldt, 1955; Randall, 1958, 1962; Limbaugh, 1961; Feder, 1966; Youngbluth, 1968; Losey, 1971, 1987; Potts, 1973b; Kuwamura, 1976). Feder (1966) defined this behaviour as "a relationship in which certain organisms (cleaners) remove ectoparasites, bacteria, diseased and injured tissue, and unwanted food particles from co-operating fish and other organisms (hosts) which visit them. This mutually beneficial behaviour results in the removal of unwanted and harmful materials from the host organisms and furnishes food for the cleaner". A variety of ectoparasites and other material may be cleaned, including caligid, lernaeid and calanoid copepods, and gnathid and cymothoid isopods (McCutcheon and McCutcheon, 1964; Youngbluth, 1968; Potts, 1973a; Losey, 1974; Flückiger, 1981; Gorlick *et al.*, 1987).

(1) Sociedad Andaluza de Biología Marina y Limnología, c/ Profesor Tierno Galván 16, 11510 Puerto Real, Cádiz, SPAIN.

In temperate marine environments, different authors have described fish cleaning interactions in waters off California (Limbaugh, 1961; Gotshall, 1967; Hobson, 1971, 1976) and western Atlantic American coast (McCutcheon and McCutcheon, 1964). Anyway, there are fewer studies of cleaning symbiosis for temperate regions than for tropical areas, perhaps by existing more unfavourable field conditions which make difficult underwater observations.

Most species of cleaner fish is found within the wrasses (Labridae). In north-eastern Atlantic and Mediterranean (CLOFNAM area, after Whitehead *et al.*, 1986) species of wrasses are fairly abundant in inshore waters, rocky grounds and eel-grass beds. Wrasses previously recorded as cleaners from this area, either in aquaria or in nature, include: *Symphodus (Crenilabrus) melanocercus* (Risso) (Wahler and Wahler, 1961; Potts, 1968; Casimir, 1969; Senn, 1979; Moosleitner, 1980; Flückiger, 1981; Michel *et al.*, 1987), *S. (C.) melops* (L.) (Potts, 1973a), *S. (C.) ocellatus* (Forsskal) (Fiedler, 1964; Moosleitner, 1980), juveniles of *S. (C.) roissali* (Risso) and *S. (C.) tinca* (L.) (Moosleitner, 1980), *Ctenolabrus rupestris* (L.) (Potts, 1973a; Larsson, 1975; Hilden, 1983; Hutcherson, 1990), juveniles of *Coris julis* (L.) and *Thalassoma pavo* (L.) (Eibl-Eibesfeldt, 1955; Moosleitner, 1980; Tassel *et al.*, 1994), and female of *Labrus mixtus* (L.) (= *Labrus bimaculatus*) (Björdal, 1991). Together with *Centrolabrus exoletus* (L.), wrasses acting as cleaners, at least during part of their lives, suppose the 41.6% of total wrasse species found in CLOFNAM area.

C. exoletus is an European wrasse which attains a length of 120-130 mm and inhabits the inshore waters over rocky and algal grounds. Its geographic distribution, in north-eastern Atlantic, ranges from Norway to Portugal, and Greenland (Quignard and Pras, 1986), although it has been also recorded in Mediterranean coasts of southern Spain (Núñez and Piote, 1981; Reina-Hervás, 1987). The first observations of rock cook as cleaner were made in Plymouth, where this species was observed picking to ballan wrasse (*Labrus bergylta* Ascanius) in the wild, which displayed an invitation posture (Potts, 1973a). However, no more cleaning data was reported in this study. Björdal (1988) considered rock cook to be the most active cleaners in aquaria. Cleaning interactions and the behavioural sequences involved was explained with more detail in field (Lough Hyne, Eire) by Breen (1990) and Hutcherson (1990), with *C. exoletus* and goldsinny (*Ctenolabrus rupestris*) as cleaners and ballan as single host. Recently, Henriques and Almada (1997) have provided data on cleaning behaviour of *C. exoletus* from Arrábida (Portugal), where the highest number of interactions was directed to *S. (C.) melops* and *L. bergylta*.

The cleaning abilities of rock cook, goldsinny and corkscrew wrasse (*S. (C.) melops*) are effective in controlling sea-lice (Copepoda, Caligidae) infestations in commercial Atlantic salmon farms in northern Europe (Norway, Ireland and Scotland), in order to eliminate or reduce the need for chemical treatments; in these experiments, it seems less effective the cleaning activities shown by female of *Labrus mixtus* (Björdal, 1988, 1991; Costello and Björdal, 1990; Costello, 1993, 1994; Darwall *et al.*, 1991-92; 1992).

There is scarce information available on biology of *C. exoletus*. Only Sayer *et al.* (1996) have studied the seasonal, geographical and sexual variation of growth, diet and condition of rock cook from west coast of Scotland. The aim of this paper is to describe the cleaning behaviour of this species in the southern limit of its distribution (Gibraltar Strait area) and compare it with that exhibited by the Mediterranean wrasse *Symphodus (C.) melanocercus*, which is considered as the most active cleaner in CLOFNAM area (Wahler and Wahler, 1961; Potts, 1968; Casimir, 1969; Senn, 1979; Flückiger, 1981). In

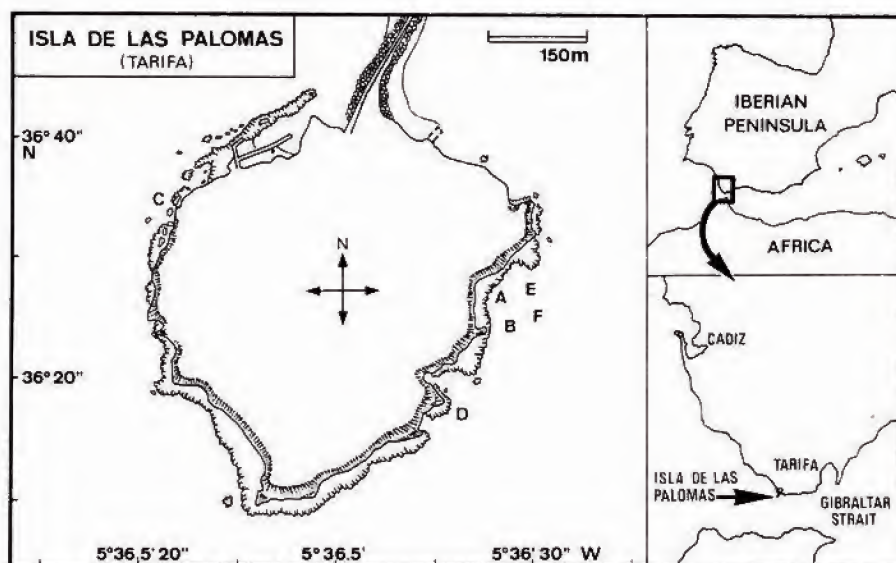


Fig. 1. - Geographic location of Isla de las Palomas. Observation and sampling stations are indicated by capital letters (from A to E).

addition, the gut contents are analyzed, especially to see the incidence of ectoparasites as prey items in diet and establish a comparison with the food preferences of rock cook from Scotland.

MATERIAL AND METHODS

Study area

The present study was conducted on eastern and western rocky shores immediately surrounding Isla de las Palomas (Tarifa, province of Cádiz, Spain), the most southern point of Iberian Peninsula ($36^{\circ}00'30''\text{N}$; $5^{\circ}36'30''\text{W}$) (Fig. 1). This island is united to Tarifa town by means of an artificial isthmus. Its plant is approaching a circular with a surface of approximately 24.5 hectares and practically rocky at whole perimeter. Due to its geographic location (Strait of Gibraltar area), there is an active system of currents and tides, favouring the transport of nutrients and therefore the establishment of a rich marine flora and fauna. These strong tidal currents and wave actions as much from Atlantic Ocean as from Mediterranean Sea, together with prevailing westerly or easterly winds, produce water turbulence which usually make impossible to dive at concrete sites. Underwater topography is characterized by the presence of rocky, gravel-rocky or sand-rocky bottoms, existing marked slopes thus producing depths about 40-50 m at short distance from shore. Nearshore rocky grounds (< 15 m deep) are covered mainly by *Asparagopsis armata* (Rhodophyceae). As the depth increases, the algae are gradually replaced by Poriphora, Cnidaria, Bryozoa and Ascidiacea. During this study, the annual average of sea surface temperature ranged between 16°C and 18°C , and the underwater visibility was over 15 m. Doubtless, observations of cleaning behaviour were facilitated by transparency of water.

Observation and sampling procedures

Preliminary observations on cleaning were sporadically made during 1992 and 1993, using SCUBA gear. A more detailed study on behaviour and samples were carried out monthly during a complete year, mainly at western and eastern edges of Isla de las Palomas, from November 1994 to October 1995, at daylight hours (from 9:45 a.m. to 12:30 p.m.). Observation stations were chosen for accessibility and exposure to the sea hydrodynamics. Two dives a month were undertaken, usually in calm sea conditions by swimming out from the shore and covered a depth range from 3 to 25 m, with a mean depth about 10 m.

Behaviour field data was recorded *in situ* on acetate sheets using graphite pencils. Due to fishes are normally very sensitive to the presence of a diver, it was important and necessary to keep still on the bottom to approximately 3-4 m from the observed fishes or move slowly during field observations, thus being possible to get a closer distance without causing any changing in behaviour. However, presence of divers caused less disturb in cleaner than host fishes, which often show alarm and swim away. Most diving lasted about 60-90 minutes, depending on depth of station.

A total of 94 specimens of *C. exoleus* ranging from 46.9 to 107.9 mm TL (total length) were collected using hand nets (1.5 m², 6 mm mesh size). This material was obtained near the shore, at 6 stations (Fig. 1). The fish was measured fresh and dated, and their TL was annotated. They were killed by prolonged anaesthesia (Quinaldine) and were latterly kept frozen in sea water.

Gut content analysis

To determine the food habits of rock cook in the study area, the contents of the whole digestive tract of sampled specimens were analyzed, 92 of which contained food. As most wrasses, rock cook have not got a differentiated stomach (Quignard, 1966) and the gut contents were taken from the full length of the gut, transferred to water and identified under a binocular microscope. Immediately after dissection, the fishes were preserved in 70% alcohol. Food organisms were grouped into major categories, i.e. copepod crustacea. In case of ectoparasites, prey identifications are given to family and generic level.

The results were analyzed for each specimen by the occurrence method (Hyslop, 1980), in which the occurrence of each food item is expressed as the percentage of fish in the sample containing them. This method was employed due to it is quick, simple, and provides sufficient information on how regularly particular food organisms are taken up by a fish population. Only guts with food were used in this calculation. Two size classes have been established in order to compare the feeding habits between juvenile and adult fish: class J (TL < 70 mm) and class A (TL > 70 mm), respectively. These size groups have been determined on the basis of the macroscopic observation of gonads, by means of which the smallest fish in Tarifa with developed gonads had 70.7 mm TL (sampled in April). Data by Sayer *et al.* (1996) are practically coincident for rock cook from the west coast of Scotland, since they found that juveniles were mostly of indeterminate sex and ranged from 43 to 71 mm TL. Furthermore, in order to obtain data on seasonal changes in the cleaning activity, the mean number of ectoparasitic organisms per feeding fish was calculated monthly.

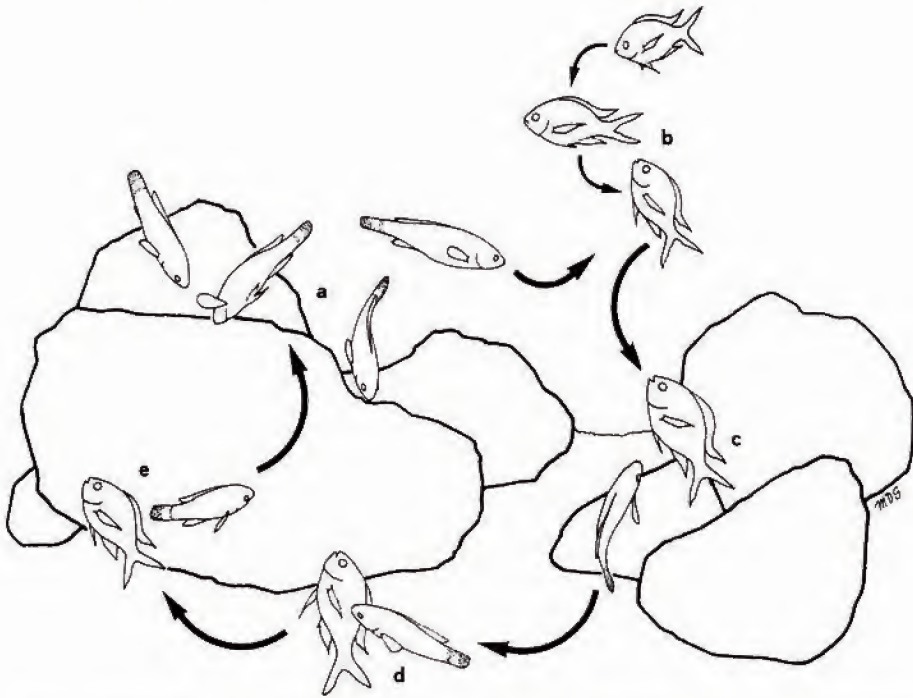


Fig. 2. - Typical cleaning sequence involving *C. exoletus* as cleaner and *Chromis chromis* as host. When a group of potential cleaners approaches (a), the host assume a head-up posture (b). Cleaner responds by approaching and starting a brief inspection of body surface of host (c). After this, the cleaning activity is initiated (d) until the cleaner shows progressively less interest and swim away returning to the feeding group (e).

RESULTS

Pre-cleaning behaviour

Rock cook does not establish well-defined cleaning stations at which receives other fishes seeking to be cleaned. *C. exoletus* moves from place to place, swimming slowly in pairs or small groups from 3 to 8 individuals, although sometimes they can be seen solitary. They appear near the substrate, nipping on rock and algae (Fig. 2a), approaching and cleaning other fishes in different areas, usually between 3 and 25 m in depth. During dives, cleaners often remained within locations encompassing a maximum of about 200 m² (station A).

The cleaner does not exhibit any attracting display before cleaning. Encounters can be initiated as much by the cleaner as by the host. In the first case, less common, the host does not attempt to initiate cleaning, but this activity is initiated by the cleaner. Thus, the cleaner swims with accelerated movements directly toward the non-posturing host, which approximately stays between 0.5 and 1 m away, for which it seems that the cleaner is able to see ectoparasites, fungal infestations or necrotic tissues on the host body surface from certain distance. However, after cleaning has been initiated, the soliciting posture usually is assumed by host. In the second case, more common, the cleaning is initiated by the host (Fig. 2b). When a cleaner swims close to a potential host, this

pauses in its swimming and adopts an unusual posture, to which rock cook responds by approaching or remaining unresponsive. Posing hosts assume a characteristic display, remaining motionless, holding all unpaired fins spread, laying the longitudinal axis of its body either upward (head-up display) or downward (head-down display) by simultaneously sculling pectoral and caudal fins for stabilizing themselves. There are not apparent changes in coloration of either the host or the cleaner; only in few cases *Symphodus* species were quite pale in colour, in contrast to the usual dark appearance of them. But the invitation pose varies for each host species. Head-up displays are performed by wrasses (Labridae), sea basses (Serranidae) and damselfish (Pomacentridae); instead, head-down displays are typical in sea breams (Sparidae) and mullets (Mugilidae). The angle of the pose varied from 45° to 90° with respect to the horizontal. Anyway, in many occasions, postures were governed by the prevailing water current. Unusually, posed fish species did not display any posture when they were cleaned, particularly when cleaning was initiated by cleaner (this behaviour was observed in *Coris julis*, *Boops boops* (L.), *Diplodus puntazzo* (Cetti) and *Serranus* sp.). Only *Mullus surmuletus* L. and *Serranus scriba* (L.) were cleaned while they rested on the bottom, with no displaying any posture, in a normal horizontal position, while rock cook moved around their body surfaces nipping at them. The host fish species will be detailed below.

Once the cleaner is attracted, whether one solitary individual or one another separated from a group, swims toward the host and slowly inspect it. While inspecting (Fig. 2c), rock cook swims close to host but does not contact physically with it, keeping a distance about 2-4 cm. After a brief visual inspection, the cleaning activity is started. On several occasions, the cleaner does not show any interest by one posturing host, for which the cleaning does not become to occur.

Cleaning

During cleaning encounters, rock cook swims about host, pausing briefly to pick at a part of this body (Fig. 2d). These picks are usually make through dorsal, caudal and head areas of the host, especially at the bases of fins. Flanks and bellies are attended with less frequency. During this study, rock cook at no time were seen cleaning the oral or branchial cavities of hosts, in spite of some hosts (usually wrasses) kept sometimes the mouth opened and the opercular covers raised. Most of cleaning interactions or bouts occur between 0.30 and 1.50 m over substrate. However, when hosts were *Anthias anthias* (L.) or *Mugil cephalus* L., cleaners swam up to 4 or 5 m. This type of cleaning was sporadic in occurrence, being observed with frequency on some days, and not at all on others.

Each cleaning bout usually do not exceed 30 sec upon a single host. The cleaner nips at the body of host from 1 and 18 times per bout (2-3 times per 5 sec), then continuing on its way. Cleaning activity of rock cook is not limited to removing ectoparasites from body surfaces of hosts. Nevertheless, if hosts showed epidermal fungal or bacterial infections, the bout lasted as long as several minutes, being frequent this with semistationary groups of *Mugil cephalus*; in one occasion, cleaning actions were led to an infested caudal fin of *Diplodus sargus* (L.). Sometimes, after inspecting the host, the cleaner did not pick at its body. In the most of times, a single cleaner attended just a single host, but in one occasion it could be observed how three cleaners simultaneously cleaned to one specimen of *Labrus merula*. Between cleaning bouts, rock cook swims slowly from one part to another, inspecting and picking on algal-covered rocky grounds. Sometimes also feeds in midwater. Generally, soon cleaner shows progressively less interest in the host

until cleaning activity is finished (Fig. 2e). On other occasions the host ceases to posture and swims off, and then the cleaner moves away.

Cleaning behaviour of *C. exoletus* is not limited to any concrete stage in its life history, since juvenile and adults cleaners could be observed. However, it was not possible to identify the sexes in the field either from their external appearance or from their behaviour. The fishes most frequently cleaned were those which at the same time were most abundant in the area. At a same day, cleaning could involve rock cook cleaning one or more individuals of a single or distinct species. On the other hand, in 6 days of observation (from middle March to middle June) rock cook was found in deeper waters and cleaning activity was not seeking.

During this study, *C. exoletus* cleaned to 18 fish species. Some fishes are cleaned with more frequency than others and other species did not seem to interact with cleaners at all, i.e. moray eels and scorpaenids. Moreover, benthic fishes smaller than rock cook, as blennies and gobies, were never cleaned. Intraspecific cleaning among conspecific of *C. exoletus* has not either been observed. In Tarifa, the fish species cleaned with more frequency was *Chromis chromis* (L.) (21% of bouts), even during the territorial nesting period of this species. Damselfish is one of the most abundant fish in inshore waters of Isla de las Palomas, where it swims in large stationary aggregations. Other fish observed being cleaning by rock cook were: *Labrus merula* (16,6% of bouts); *Coris julis* (12,1%); *Symphodus melops* (9%); *Sarpa salpa* (L.) and *Anthias anthias* (6% each); *Serranus cabrilla* (L.) and *Mugil cephalus* (4,5% each); *Diplodus sargus*, *D. puntazzo*, and *Oblada melanura* (L.) (3% each); *Diplodus vulgaris* (G. Saint-Hilaire), *Boops boops*, *Symphodus* (*C.*) *roissali*, *S. (C.) mediterraneus* (L.), *S. (C.) ocellatus*, *Serranus cabrilla* (L.) and *Mullus surmuletus* (1,5% each). The fish families more frequent acting as hosts in cleaning interactions were Labridae (42,2% of bouts), Pomacentridae (21,2%), Sparidae (18%) and Serranidae (12%).

Diet

Table I shows the food habits of *C. exoletus* in Tarifa, indicating that feeds predominantly on benthic organism, although a good part of diet depending on its cleaning habits. It is interesting to indicate that fish scales and substance like mucus have been found into the guts. There were greater percentages of algae fragments and sand grains, possibly due to their incidental ingestion as part of benthic trophic habits of rock cook rather than fed upon directly. Feeding habits between size classes were relatively similar. The preferential preys were free-living copepods (91.3% of occurrence). But major prey items taken by rock cook through cleaning were isopod larvae of *Gnathia* sp. (84.7%), constituting the second prey in occurrence. Of the 92 specimens with food, only 14 individuals contained non parasitic prey and 77 contained both ectoparasites and non parasitic prey (the gut of remaining specimen only had a single gnathiid). Rarely ectoparasitic copepods were taken (*Caligus* sp. and *Hatschekia* sp.). Food analysis of rock cook in Tarifa shows a clear seasonal variation as regards the ingestion of ectoparasitic prey through cleaning habits (Fig. 3). This activity increased gradually from March, with a maximum in August; however, from September it started to decrease progressively. Nevertheless, data of November and December must be considered as superficial because the peak of the former was a consequence of an uncommon number of parasites found in a single individual (116), and December had a low number of samples (3).

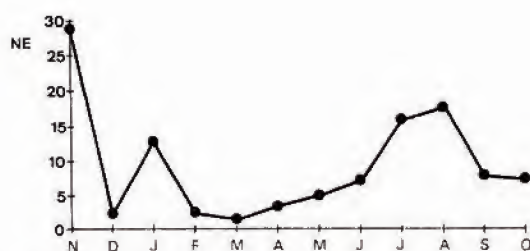


Fig. 3. - Mean number of ectoparasitic prey per cleaner fish (NE) during a whole year (from November 1994 to October 1995).

Table I. - Analysis of the diet composition (by frequency of occurrence method) of *Centrolabrus exoletus* from Tarifa (Strait of Gibraltar area). Size classes are indicated by A (adult) and J (juvenile).

Prey	A + J	A	J
Crustacea			
Copepoda			
Parasitic			
Caligidae (<i>Caligus</i> sp.)	2.1	3.1	0.0
Hatschekidae (<i>Hatschekia</i> sp.)	8.6	10.9	3.7
Non parasitic	91.3	89.0	85.7
Isopoda			
Parasitic			
Gnathiidae (<i>Gnathia</i> sp.)	84.7	82.8	89.2
Non parasitic (mostly Anthuridae)	21.7	26.5	10.7
Cirripedia	40.2	31.2	60.7
Amphipoda	59.7	60.9	57.1
Ostracoda	19.5	21.8	14.2
Decapoda	13.0	14.0	10.7
Cumacea	3.2	3.1	3.5
Anisopoda (Tanaidae)	42.3	43.7	32.1
Cladocera	2.1	3.1	0.0
Polychaeta	42.3	43.7	39.2
Foraminifera	14.1	12.5	17.8
Mollusca			
Gastropoda	38.0	40.6	32.1
Bivalvia	16.3	17.1	14.2
Echinodermata	6.5	9.3	0.0
Arachnida			
Acari	9.7	12.5	3.5
Insecta			
Chironomid	4.3	3.1	7.1
Coleoptera	1.0	1.5	0.0
Diptera	1.0	1.5	0.0
Hydrozoa	4.3	6.2	0.0
Invertebrate eggs	9.7	9.3	10.7
Fish scales	13.0	15.6	7.1
Substance like mucus	11.9	14.0	7.1
Algae fragments	33.6	34.3	32.1
Sand grains	36.9	40.6	28.5
Guts examined	92	64	28

DISCUSSION

Our observations of cleaning at Isla de las Palomas were sufficient to recognize *C. exoletus* as a facultative cleaner. Fundamental parallels exist between the cleaning behaviour of rock cook from Tarifa and those of Lough Hyne (Breen, 1990; Hutcherson, 1990) and Arrábida (Henriques and Almada, 1997). In the latter paper, rock cook cleaned a total of 12 species, being *S. (C.) melops* and *L. bergylta* the most frequent hosts. At Arrábida, *C. exoletus* was the only cleaner and, as well as Tarifa, cleaning behaviour occurred in all seasons. However, during our study, we also have seen other two species cleaning, but occasionally: juveniles of ocellated wrasse (*Symphodus (C.) ocellatus*) and rainbow wrasse (*Coris julis*). The first species just on one time, cleaning on *Labrus merula*. However, *C. julis* was observed cleaning on several occasions along the observation period, detaching in an unusual interaction with groups of *Boops boops* (Otero and Galeote, unpubl. data). In addition, we have never seen in Tarifa other wrasses which have been described as cleaners acting as such (*i.e.*, *Symphodus (C.) melops*, *S. (C.) roissali*, *Thalassoma pavo* and *Ctenolabrus rupestris*). This is in accordance with Moosleitner (1980), which showed that wrasses can vary geographically in their cleaning activity.

The gut contents of *C. exoletus* from west coast of Scotland examined by Sayer *et al.* (1996) were dominated by bivalve mollusca and amphipods, in terms of percentage occurrence. But these authors failed to detect ectoparasites in the diet, although these results were relatively superficial because of low sample numbers (30). Although fishes of North Sea are more parasited by copepods than Mediterranean fishes (Wahler and Wahler, 1961), parasitic copepods did not either appear. However, rock cook of Tarifa shows a diet that clearly reflects its cleaning habits throughout the whole year, although ingestion of ectoparasites appears to be correlated with temperature. Senn (1979) and Flückiger (1981) found a similar relationship in *Symphodus (C.) melanocercus*, with a maximum feeding intensity of larval gnathiid isopod in summer. Unfortunately, Henriques and Almada (1997) do not provide data on feeding of *C. exoletus* from Arrábida.

S. (C.) melanocercus is an endemic species from Mediterranean which occupies the littoral rocky areas and eel-grass beds from 1 to 25 m (Quignard and Pras, 1986). Thus, there is not overlap between geographic distribution of this species and *C. exoletus*. However, *C. exoletus* has been reported in a little Mediterranean area at southern of Iberian Peninsula (Núñez and Piote, 1981; Reina-Hervás, 1987). In this area, Reina-Hervás (1987) carried out a study of the inshore small-mesh trawling survey, where *C. exoletus* was caught but *S. (C.) melanocercus* was not. We have not seen individuals of *S. (C.) melanocercus* either along this stretch of Spanish coast. Moreover, our own observations and those of other authors (Quignard and Pras, 1986; Michel *et al.*, 1987; Costello, 1991) indicate that rock cook inhabits the same ecosystems than for *S. (C.) melanocercus*.

Several marine benthic feeders are behaviourally and morphologically preadapted to clean (Hobson, 1971), so being able to make use of an alternative niche with effectiveness. In taking material from the bodies of other fishes, rock cook uses the same picking technique that employs to pick small invertebrates from substrate or that are adrift in midwater. Its pointed snout and dentition, which are similar to those of *S. (C.) melanocercus*, are well suited to cleaning, although the degree of specialization for this habit varies greatly from highly specialized species of the Indo-Pacific labrid genus *Labroides*, which feeds almost exclusively on ectoparasitic crustaceans (Randall, 1958; Youngbluth, 1968; Potts, 1973b). In spite of body shape and colour pattern (general pigmentation and dark caudal spot) are very similar in *C. exoletus* and *S. (C.) melanocercus*, it is not reliable that

the host fish only recognize these colour patterns or "guild marks", as it was suggested by Eibl-Eibesfeldt (1955). Cleaner recognition by host must be primarily understood as a result of host experience with the cleaner, where the capacity of delivering tactile stimulation may play an important role in this learning (Losey, 1971, 1979, 1987).

Otero and Galeote (1994) related aspects of dentition with cleaning activity in cleaner wrasses. Premaxilla and dentary teeth of *C. exoletus* and *S. (C.) melanocercus* seem especially suited to remove ectoparasites, due to the presence of canines projecting forward at the front of each jaw. Diet of these two species are also similar. Among prey making up diet of *S. (C.) melanocercus* are included bryozoans, hydrozoans, polychaeta and free-living crustacea as small amphipods and copepods (Quignard and Pras, 1986; Michel *et al.*, 1987). Stomach samples analyzed by Senn (1979) contained almost exclusively praniza larvae of *Gnathia* sp. This author verified that ingestion of these ectoparasites was greater on summer than fall, and other food items were observed inside stomachs of cleaners collected on September and October. Flückiger (1981) indicated that this species probably feeds in a conventional way during winter, since ectoparasite density varies from year to year and among distinct environments. Similarly, our results indicate that rock cook feeds on small invertebrates, as Copepoda, Amphipoda, Polychaeta, Anisopoda, Cirripedia and Gastropoda, being larvae of *Gnathia* sp. an important food source obtained from cleaning symbiosis. Campos and Carbonell (1994) have verified that larvae of *Gnathia vorax* are very frequent on gills, mouth and skin of Mediterranean wrasses as *Symphodus (C.) tinca* and *Labrus merula*.

But there are differences in intraspecific and interspecific behaviour between both species. Usually, *S. (C.) melanocercus* is a solitary species which maintains limited territories throughout the year, where examples of intraspecific aggression are often sighted; as a cleaner fish, this species develops chromatic changes used as predisposition signal to clean, acting in permanent cleaning stations at which receives other fishes seeking to be cleaned (Wahler and Wahler, 1961; Potts, 1968; Casimir, 1969; Heymer, 1972; Senn, 1979; Lejeune and Voss, 1980; Flückiger, 1981; Lejeune, 1985). Instead, our underwater observations show that *C. exoletus* normally swims from place to place, tends to form small groups over relatively large areas, and any agonistic or sexual interaction among members of this species has never been observed. On the other hand, rock cook does not establish clear cleaning stations. Furthermore, this species does not adopt any attracting display to clean, remaining in "feeding stations" where alternate its food sources as much from cleaning activity as from small benthic or pelagic invertebrates.

As conclusion, we can state that *C. exoletus* must be included, next to *S. (C.) melanocercus*, into the group of facultative or part-time cleaners, due to much of their diet is derived from other food sources. In accordance with all data exposed above, we can establish that these two species are the most active cleaners in their respective geographic areas.

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